

Loop Heat Pipe with Thermal Control Valve for Passive Variable Thermal Link, Phase II

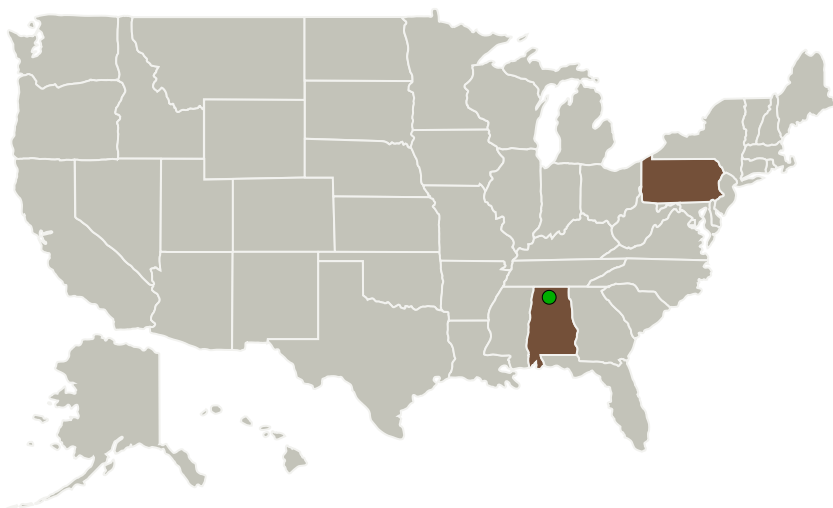
Completed Technology Project (2011 - 2013)



Project Introduction

Future Lunar Landers and Rovers will require variable thermal links that can reject heat during daytime, and passively shut-off during lunar night. During the long lunar day, the thermal management system must remove the waste heat from the electronics and batteries keep them within the acceptable temperature limit. Since the heater power availability is restricted, a variable thermal link is therefore required to limit the amount of heat that is removed from the electronics and radiated to space during the long lunar night. Conventional Loop Heat Pipes (LHPs) can provide the required variable thermal conductance, but they consume electrical power to shut down the heat transfer. Our innovation adds a Thermal Control Valve (TCV) to the LHP, allowing it to passively shut off without consuming any electrical power. This is important since there is a severe penalty for electrical power consumption: supplying 1 W in a photovoltaic system requires roughly 5 kg of extra equipment. The TCV used in the LHP has been previously selected for thermal control in the pumped loop on the Mars Science Laboratory. The Phase I project was successful in demonstrating the feasibility of integrating the TCV in a LHP. The Phase II project will fabricate and test a LHP with a TCV at representative conditions, bringing the technology to TRL 6. The testing will include full characterization of the TCV under various LHP operation modes. Analysis and testing of different LHP condenser layouts will also be performed, as well as freeze/thaw analysis.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Advanced Cooling Technologies, Inc.	Lead Organization	Industry	Lancaster, Pennsylvania
● Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	Pennsylvania

Project Transitions

June 2011: Project Start

August 2013: Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/139044>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Advanced Cooling Technologies, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

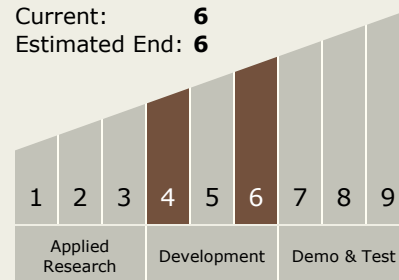
Carlos Torrez

Principal Investigator:

John Hartenstine

Technology Maturity (TRL)

Start: 4
Current: 6
Estimated End: 6



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Technology Areas

Primary:

- TX14 Thermal Management Systems
 - └ TX14.2 Thermal Control Components and Systems
 - └ TX14.2.2 Heat Transport

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System